Spring 2019

Spring 2019 News: Saturated bufers remove nitrates from tile drainage water

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Saturated buffers remove nitrates from tile drainage water

BY CHRISTIE DELFANIAN | APRIL 23, 2019

A perforated distribution line is embedded parallel to and at least 30 feet from the stream in the saturated buffer at the Flandreau site. South Dakota State University researchers evaluated the use of saturated buffers in eastern South Dakota.

Saturated buffers can provide a cost-effective means of removing nitrates from tile drainage water before it flows into adjacent creeks and streams. However, the site must meet specific guidelines.

“A saturated buffer allows the soil system itself, whether through plant uptake, microbial conversion or filtration, to help reduce nitrate concentrations,” explained Assistant Professor Rachel McDaniel of the South Dakota State University Department of Agricultural and Biosystems Engineering. She is also a water resource engineer for the South Dakota Water Resources Institute and receives research funding through the South Dakota Agricultural Experiment Station at South Dakota State University.

McDaniel and several department colleagues, including Professor Todd Trooien, evaluated the use of

saturated buffers in eastern South Dakota. Master's student Abhinav Sharma, who graduated in 2018, also worked on the project.

The project was supported by a three-year, $75,000 Conservation Innovation Grant from the U.S. Department of Agriculture's Natural Resources Conservation Service, as well as matching funds from the South Dakota Farm Bureau, East Dakota Water Development District and the South Dakota Soybean Research and Promotion Council. "Only through the vision and support of these diverse funding groups and programs were we able to establish these saturated buffer demonstration sites and measure the benefits to water quality," noted Trooien.

In 2015 and 2016, the researchers installed saturated buffers at two sites, one near Flandreau and another near Baltic. Both sites had established riparian buffers, strips of grass, shrubs and trees at the edge of the waterway that filter nutrients from surface runoff.

Though the original project concluded last year, South Dakota Water Resources Institute personnel at South Dakota State will continue nitrate sampling to collect long-term datasets.

Site specifications

In a saturated buffer, a control structure diverts flow from the drain tile outlet into a perforated distribution pipe that runs parallel to and at least 30 feet away from the waterway. "You want water to flow slowly through the vegetation strip so the plants and microbes have a chance to work," McDaniel said. In addition, the waterway into which the drainage flows should be less than 8 feet deep to help prevent bank failure.

To install a saturated buffer, the water body must be less than eight feet deep.

"The buffer strip must have a relatively low slope, about 1 percent; however, the land being drained does not have to have that consistent low slope—it can be variable," McDaniel continued. The soil should have at least 1 percent carbon content at the 2.5-foot depth and at least 1 foot of soil should cover the top of the distribution pipe.

A saturated buffer is designed to handle at least 15 percent of the capacity of the tile drainage system. "That size is large enough to have water quality benefits without making the buffer too large and expensive," Trooien said.

"As long as the flow is low enough, it goes through the saturated buffer," she said. A bypass prevents excess water from backing up into the field.

Nitrate removal rates

Researchers used water samples from the control structure to determine the initial nitrate levels at the two sites. “We took the concentrations of nitrates directly from the water coming out of the tile, so we know what is going directly into the stream,” McDaniel said. They calculated nitrate removal rates using an array of shallow wells positioned across the saturated buffers.

The Baltic site showed nitrate removal rates in the 90 percent range of the water that passes through the saturated buffer. The removal rates at the Flandreau site varied quite a bit, but McDaniel reported, on average, about 65 percent reduction in nitrate levels.

“In general, saturated buffers seem like an effective tool for nitrate removal, but they are limited to areas that meet the site-specific conditions,” McDaniel said. “It’s one of the new tools in the toolbox for those areas.”

The control structure, to the right, directs flow to the saturated buffer and allows researchers to take water samples.

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